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TOYOTA
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October 2, 1991

Ms. Mary T. Smith, Director
Field Operations and Support Division (EN-397F)
U.S. Environmental Protection Agency
401 M Street S.W.
Washington, D.C. 20460

Subject : MMT Fuel Additive Waiver

Dear Ms. Smith :

We are herewith submitting to your office Toyota's Comments on the Ethyl Application for a MMT Fuel Additive Waiver along with Attachments showing test results and conclusions.

We would appreciate EPA's careful consideration of the comments as a part of the regulatory process.

If you have any questions regarding the enclosed information please contact Mr. Robert Babcock of my staff.

Sincerely,

Takao Niwa

Takao Niwa
General Manager
Emission Certification Dept.

TOYOTA TECHNICAL CENTER, U.S.A., INC.

Toyota's Comments on the Ethyl Application for a MMT Fuel Additive Waiver

1. MMT Effects on Exhaust Emissions

Toyota has conducted an emission durability test on a '90 MY Camry using gasoline with 1/32 grams per gallon MMT added. The test results and test conditions are shown in Attachment 1. The data clearly shows that total HC emissions increase with MMT gasoline, and that CO emissions also increase slightly. NOx emissions are not dramatically affected.

The increase in HC emissions correspond to our past test results with 1/16 grams per gallon MMT added to the gasoline. The data indicates that the reduced concentration of MMT still adversely affects exhaust emissions. The only difference is that the adverse effects occur later with reduced concentrations.

Since the emission control system on all Toyota vehicles is basically identical to that of the Camry tested, other Toyota vehicles will be adversely effected in the same manner by the use of MMT.

Regarding particulate emissions, we measured the emissions after completion of 30,000 miles of vehicle operation. The results show that particulate emissions from a vehicle using an MMT additive increase by 150 percent over vehicles not using the MMT additive. We believe that particulate emissions are emitted in the form of manganese oxide.

The vehicle tested had two oxygen sensors installed, one is upstream (front) and the other is downstream (rear) of the catalyst. Since manganese deposits collected on both oxygen sensors, this is additional evidence that particulates pass through the catalyst and are emitted to the ambient air. It is expected that the particulate emissions will increase as the vehicles mileage increases.

2. MMT Effects on Catalyst Conversion Efficiency

After the 30,000 mile durability test, we analyzed the performance of the catalyst and the oxygen sensor. Attachment 2 shows the catalyst conversion performance, and Fig. 1 in attachment 3 shows the manganese deposits on the catalyst. These results indicated that the HC and CO conversion performance of the catalyst deteriorates by the use of MMT, and this results in a vehicle emission increase.

When using MMT, the catalyst 50% conversion temperature is 14-15°C (25-27°F) higher and conversion performance at 350°C (662°F) is 25-28% lower than the case without MMT. Furthermore, although the NOx exhaust emissions are not affected by the use of MMT, NOx conversion performance of the catalyst deteriorates in the same manner as HC and CO conversion performance.Therefore, it is apparent that the use of MMT significantly deteriorates the catalyst activation.

The manganese deposits in the catalyst are estimated to be about 3 weight % in the front portion of the catalyst. We believe these deposits are the cause of the deterioration of the catalyst. Further, if the vehicle accumulates more mileage, the manganese deposits will expand throughout the entire catalyst , making the adverse effects of MMT even more serious.

3. MMT Effects on Oxygen Sensor Performance

Fig. 2 in Attachment 3 shows the manganese deposits on the oxygen sensor. Large amounts of deposits adhered on both the front and rear oxygen sensors. These amounts are 28.2 weight % and 21.2 weight %, respectively. Since the deposits formed are porous, initial adverse effects on the oxygen sensor characteristics are not significant. However, if solid deposits or larger amounts of deposits are formed, the oxygen sensor performance would deteriorate.

4. Conclusions

It is Toyota's conclusion that the use of MMT causes deterioration of the emission control system resulting in an emissions increase. Further, the allowance of an MMT additive may have an adverse affect on a manufacturers ability to comply with more stringent emission standards in the future. Therefore, Toyota requests EPA to reject the Ethyl application for a MMT additive waiver.

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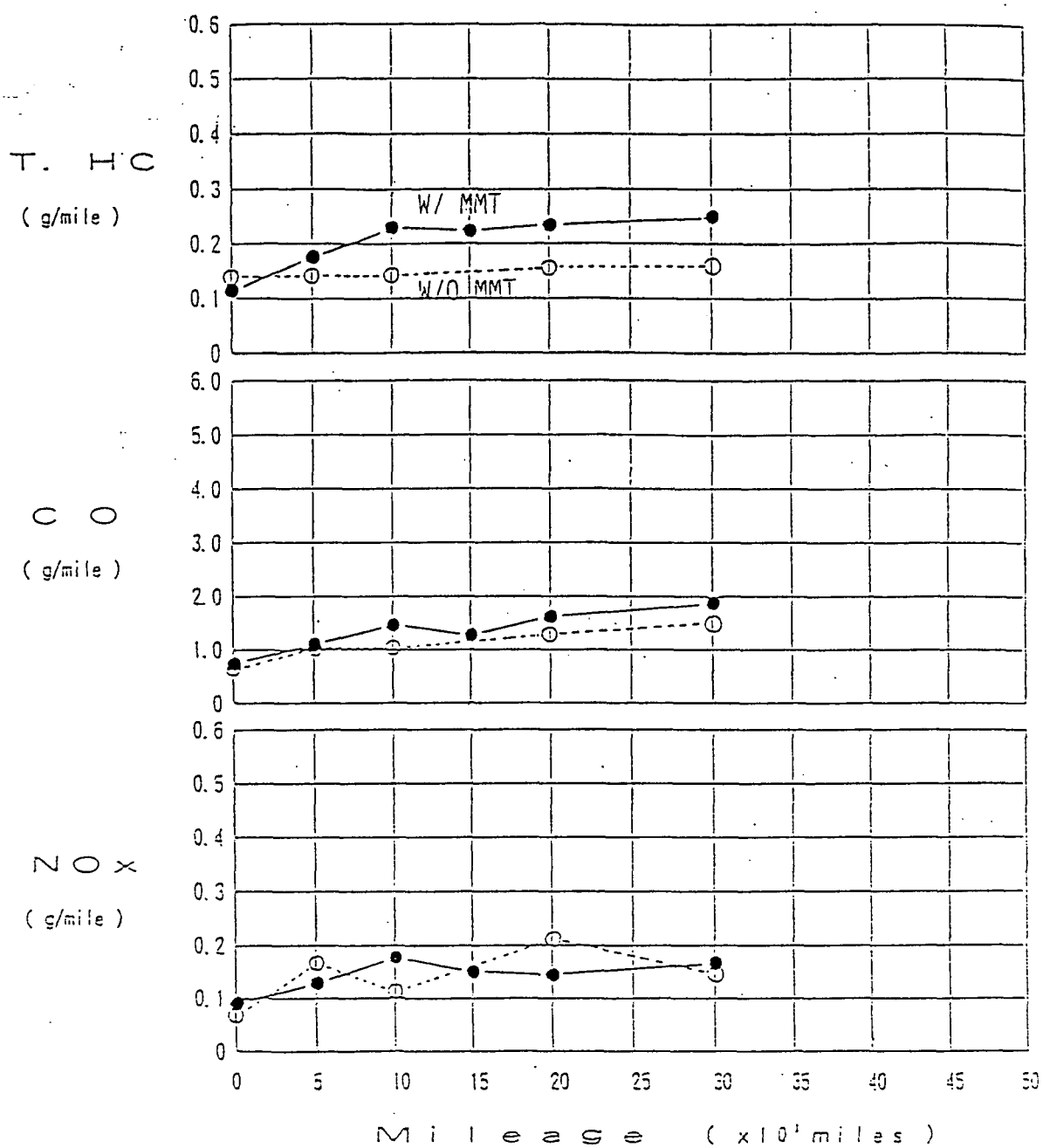
3. Test Results



Part.
(g/mile)
at 30 × 10³ miles

W/ MMT	0.0045
W/O MMT	0.0029

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ATTACHMENT 1

1. Test Vehicle and Engine

Vehicle : '90 MY Camry Sedan, 4 A/T
Engine : 3S-FE (2.0L, L4)
Emission Control System : Multipoint Electronic Fuel Injection + 2 Three Way Catalysts (Close-coupled and Underfloor catalysts) + 2 Oxygen Sensors

2. Test Conditions

(1) MMT Additive 1/32 g/gallon Mn

(2) Mileage Accumulation Fuel Characteristics

RON	91.4
MON	81.5
RVP	9.9 psi
Distillation Range	
IBP (Degrees F)	85
10%	119
50%	211
90%	343
EP	402
Olefins (vol. %)	6.8
Aromatics (vol. %)	36.5

(3) Mileage Accumulation Mode
Toyota in-house durability driving mode

(4) Emission Test Fuel
EPA certification test fuel

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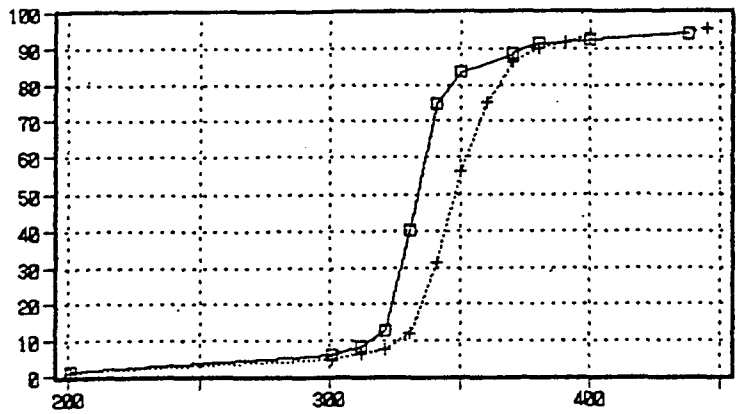
ATTACHMENT 2

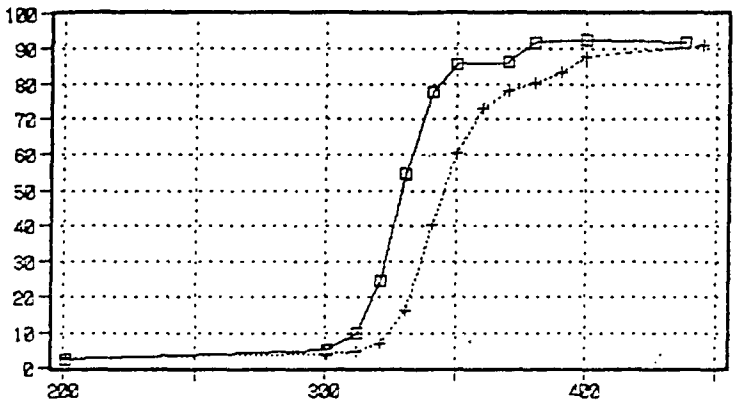
HC CONVERSION



INLET TEMP. °C

□ W/O ΠΠΓ + W/ ΠΠΓ

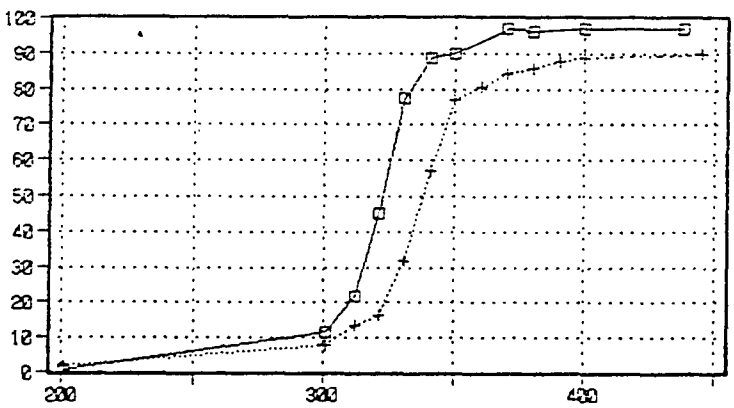
CO CONVERSION



INLET TEMP. °C

□ W/O ΠΠΓ + W/ ΠΠΓ

NOx CONVERSION



INLET TEMP. °C

□ W/O ΠΠΓ + W/ ΠΠΓ

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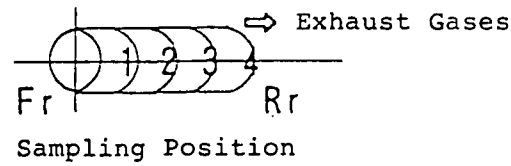
ATTACHMENT 3



Sampling Position

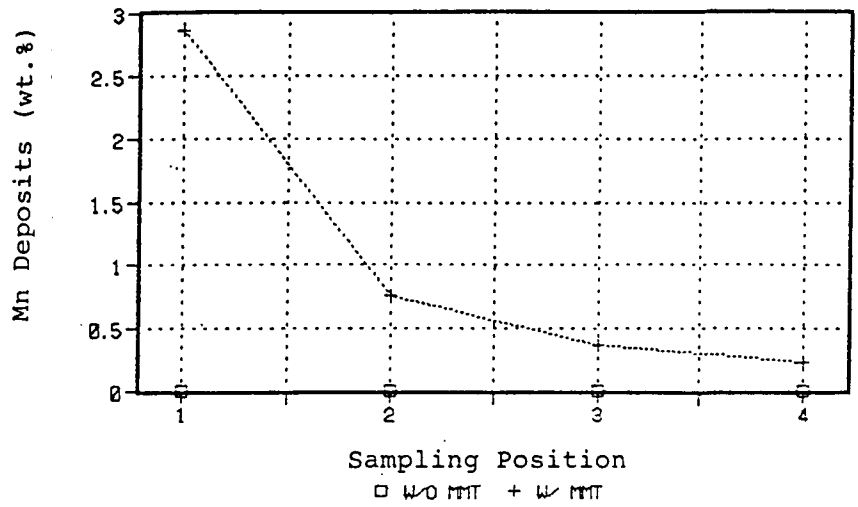


Fig. 1 Mn Deposits in the catalyst

Oxygen Sensor		Front	Rear
Mn Deposits	W/O MMT	0	0
(weight %)	W/ MMT	28.2	21.2

Fig. 2 Mn Deposits on the Oxygen Sensor